Assignment 7

EE 553 Power System Economics

Due May 25th, 2017 at 8pm. Email to ywang11@uw.edu

Problem 1. Consider a two bus system (A and B) connected by a transmission line. Suppose bus A has a supply function of

$$\pi_A = 9 + 0.015P_A$$

where π_A is the price of electricity, and bus B has a supply function of

$$\pi_B = 11 + 0.2P_B$$

where π_B is the price of electricity. The demand at A is 300 MW and at B is 900 MW.

1. Suppose there is no congestion in the system. To minimize the total generation cost, how much should be generated at A and B? What is the equilibrium price?

2. Now suppose the transmission line has a capacity of 350MW. What is the generations at buses A and B? Find the clearing prices at A and B.

3. What is the revenue for generators at A and B, respectively?

4. Demand pays at the locational marginal price, that is, demand A pays $\pi_A D_A$ and demand B pays $\pi_B D_B$, where π_A (π_B) are clearing prices and D_A and D_B are the demands. What is the total payments of demand A and demand B? What is the congestion surplus?

Problem 2. Consider the 3 bus network in Fig. 1. The generator A at bus 2 is trying to send 500 MW to the load at bus 3. The lines all have the same reactances.

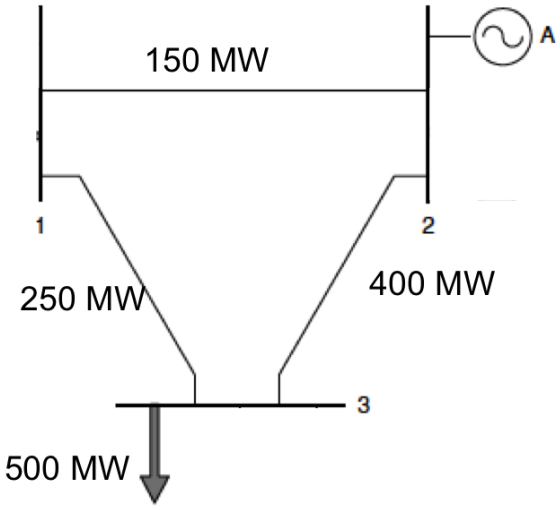

Figure 1: Network for problem 2.

1. Given the line capacities, what is it possible to transfer 500 MW from bus 2 to bus 3? If not, what is the maximum power that can be delivered?

2. Now suppose the price of generation at bus 2 (use generator A) is 1\$/MW. A new generator is installed at bus 3 with a price of 2\$/MW. Subject to the transmission line capacities, what is the minimum cost of satisfying 500 MW at bus 3?

Problem 3. Consider the 3 bus network in Fig. 2 with data given in Tables 1 and 2. Find the least cost generating solution satisfying all the loads and line flow capacities.

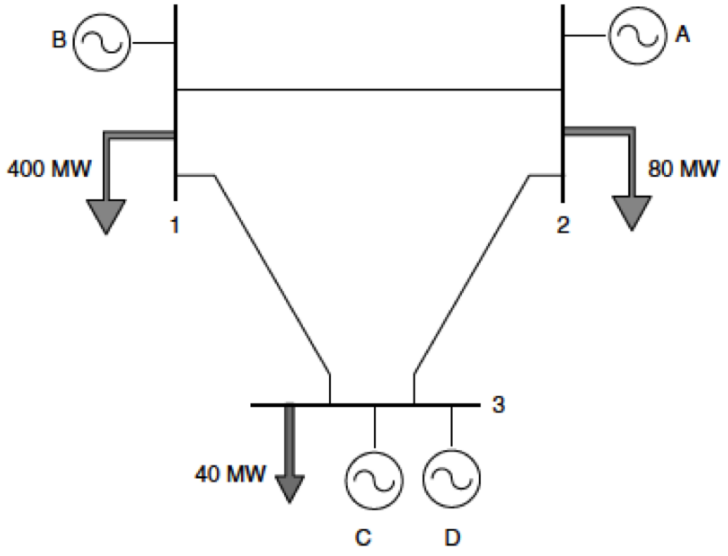

Figure 2: 3 bus network for problem 3

Generator	Capacity (MW)	Marginal Cost (price) ($/MWh)
A	150	12
B	200	15
C	150	10
D	400	8

Table 1: Generation data for problem 3.

Branch	Reactance	Capacity (MW)
1-2	0.2	250
1-3	0.3	250
2-3	0.3	250

Table 2: Branch data for problem 3.